

PRACTICE IN THE CASE OF TYPEWRITING

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In 1907-1908 Mr. Hill and Mr. Rejall learned to typewrite under experimental conditions, and kept careful records of the work done daily, the errors made, and the conditions under which the work was done. These original measures have been analyzed and organized by Mr. Thorndike with results as shown in this article. He alone is responsible for the methods used and for any errors of computation apart from the original records.

The purpose of this report is to state certain facts concerning the amount, rate, limit, changes in rate, conditions, and permanence of improvement in the case (1) of typewriting one same 100-word paragraph and (2) of copying a page of approximately 300 words of changing material.

The original measures are given in full in Table I. It should be noted that since the daily task was to copy a constant amount, the daily time given to practice decreased as the experiment progressed. It should also be noted that the improvement in writing the same paragraph and in copying changing material is, in the case of either one, due to practice in both.

THE AMOUNT AND RATE OF IMPROVEMENT

On the first day Hill copied the 100-word paragraph at a rate of 10 words per minute with 13 errors per hundred words, and copied the 300-word page at a rate of 7.1 words per minute with 19 errors per hundred words. On November 30, December 2, and December 3, after 2.4 hours of practice with the 100-word paragraph and 10.3 hours practice with changing material, he copied the 100-word paragraph at a rate of 18.1 words per minute with $1\frac{2}{3}$ errors per hundred words, and copied the new pages at a rate of 13.9 words per minute with 3.6 errors per hundred words. On January 4, 6 and 7, after 4.7 hours of practice with the 100-word paragraph and 19.6 hours of practice with changing material, he copied the 100-word paragraph at 25 words per minute with $2\frac{1}{3}$ errors per hundred words and the new pages at 17.9 words per

TABLE 1—ORIGINAL SCORES IN LEARNING TO TYPEWRITE

		HILL						REJALL					
		Same 100-word paragraph			300-word page of new material			Same 100-word paragraph			300-word page of new material		
Time of practice	Minutes	Seconds	Errors per 100 words	Minutes	Seconds	Errors per 300 words	Minutes	Seconds	Errors per 100 words	Minutes	Seconds	Errors per 300 words	
Nov	1	10	00	13	42	00	57						
	2	10	00	12	37	00	48	15	53	8	43	50	
	3											34	
	4	9	45	13	30	30	45	10	20	5	36	32	
	5	9	00	2	31	00	43	8	50	9	33	33	
	6	8	30	6	30	30	26	9	4	9	29	24	
	7	7	45	7	27	30	23	7	29	7	25	29	
	8	7	30	4	24	45	30	6	42	5	27	22	
	9	7	5	10	26	00	24	7	8	4	25	40	
	10											19	
	11	6	45	2	24	48	27	8	5	6	29	00	
	12	7	2	3	24	30	23	6	20	9	24	23	
	13	6	43	2	25	45	16	6	25	4	23	28	
	14	6	16	8	25	19	18	5	58	7	23	30	
	15	6	25	2	22	2	17	6	15	3	22	34	
	16	?	?	3	23	23	36	7		8	22	15	
	17											26	
	18	5	46	5	21	6	23	5	23	1	20		
	19	6		4	26	26	21	5	25	8	24	35	
	20	5	25	9	21	51	37	5	10	2	22	45	
	21	5	38	6	22	43	25	4	58	4	22	21	
	22	6		4	20	52	21	4	53	7	21	13	
	23	5	19	9	21	50	11	5	8	8	20	47	
	24											18	
	25	5	23	4	21		10	4	17	2	19	5	
	26	5	35	5	20	14	12	4	38	7	18	40	
	27	5	15	3	17	37	12	4	30	1	19	18	
	28	5	15	1	18	29	16	4	24	6	20	20	
	29 ill							4	32	3	19	8	
	30	5	15	3	20	20	11	4	3	4	17	25	
Dec	1											14	
	2	6	5	1	22	32	13	4	17	3	18	27	
	3	5	15	1	22	46	8	4	10	4	18	53	
	4	5	40	6	21		16	4	4	8	17	7	
	5	5	55	3	22	20	3	4	30	6	19	23	
	6	5	16	2	21	51	7	4	31	1	17	37	
	7	4	43	0	19	25	9	Out of town					
	8												
	9	5		2	18	50	4	4	10	7	18	28	
	10	4	30	2	19	40	10	4		11	18	38	
	11	5	51	3	18	39	10	4		3	17	22	
	12	4	39	5	18	9	8	4	15	2	19	20	
	13	4	30	2	19	58	11	3	45	10	16	58	
	14	4	48	6	19		17	3	47	11	18	25	
	15											18	

TABLE 1—Continued

	HILL						REJALL						
	Same 100-word paragraph			300-word page of new material			Same 100-word paragraph			300-word page of new material			
Time of practice	Minutes	Seconds	Errors per 100 words	Minutes	Seconds	Errors per 300 words	Minutes	Seconds	Errors per 300 words	Minutes	Seconds	Errors per 100 words	
Dec	16	4	40	4	16	35	14	3	50	16	18	10	20
	17	4	31	1	18	30	11	Absent					
	18	4	27	7	17	20	15	3	30	7	16	40	21
	19	4	25	3	17	15	8	3	58	2	16	22	13
	20	4	22	1	17	50	4	3	51	1	16	30	5
	21	4	17	2	17	2	12	Absent					
	22												
	23	4	17	2	17	58	12	4	2	8	16	55	21
	24	4	10	2	16	55	8	3	37	10	16	18	22
	25	4	20	3	17	10	9	Absent					
	26	4	17	3	18	48	10	Absent					
	27	4	3	5	17	33	7	Absent					
	28	4	8	2	15	43	11	Absent					
	29												
	30	4	8	2	18		7	Absent					
	31	4		3	16	35	17	Absent					
Jan	1	3	55	1	17	6	8	Absent					
	2	3	57	2	16	32	12	Absent					
	3	4	2	1	16	25	11	Absent					
	4	3	50	3	16	11	10	3	38	9	16	38	33
	5												
	6	3	50	1	17	6	11						
	7	4	18	3	17		7	4		16	17	50	21
	8	3	50	2	16	20	7	3	40	6	17	22	16
	9	4		1	15	27	10	3	20	4	15	2	19
	10	3	40	2	15		19	3	45	4	16	27	6
	11	3	55	4	15	25	9						
	12												
	13	3	55	7	15	10	12	4	4	6	19	17	19
	14	3	35	2	15	20	6	3	43	2	15	20	14
	15	3	33	1	14	45	12	3	16	0	16	36	18
	16	3	23	3	15	12	11	3	52	0	16	44	14
	17	3	32	1	15	15	12	3	50	6	15	38	7
	18	4		1	14	10	5	3	42	2	15	12	15
	19												
	20	3	45	1	14	46	25	3	5	12	14	5	24
	21	3	36	1	14	30	9	3	5	5	15	28	17
	22	3	30	2	15	25	13	3	50	7	16	37	17
	23	3	25	4	14	50	9	3	8	5	15	21	20
	24	3	21	5	14	36	13	3	7	5	15	21	17
	25	3	30	2	15	25	13	3	16	8	15	18	12
	26												
	27	3	30	3	15	50	10	3	25	3	16	28	23
	28	3	34	1	14	16	7	3	22	6	14	56	22
	29	3	33	3	15	8	17	3	13	6	16	3	18

TABLE 1—Continued

		HILL						REJALL					
		Same 100-word paragraph			300-word page of new material			Same 100-word paragraph			300-word page of new material		
Time of practice		Minutes	Seconds	Errors per 100 words	Minutes	Seconds	Errors per 300 words	Minutes	Seconds	Errors per 100 words	Minutes	Seconds	Errors per 300 words
Jan	30	3	30	0	15	18	13	3	8	2	15	25	24
	31	3	34	5	15		16	Absent					
Feb	1	3	24	4	15	38	13	3	5	1	15	20	11
	2												
	3	3	18	4	14	25	13	3	7	6	15	28	11
	4	3	24	5	14		16	2	58	6	14	32	12
	5	3	25	2	13	45	13	3	6	3	14	20	9
	6	3	23	3	13	53	16	3	22	4	14	38	5
	7	3	30	7	13	35	8	3	10	4	13	56	7
	8	3	28	1	13	45	13	3	11	3	14	38	9
	9												
	10	3	26	4	14	45	8	3	25	5	15	20	5
	11	3	17	1	13	32	11	2	50	1	14	9	7
	12	3	17	4	14	12	10	3	10	10	14	22	20
	13	3	16	4	13	8	9	3	9	4	14	13	8
	14	3	21	4	15		7	3	13	3	13	15	9
	15	3	32	3	14	20	10	3	30	4	15	20	3
	16												
	17	3	16	4	13	30	10	3		1	13	52	11
	18	3	6	2	13	20	4	3	10	3	14	9	8
	19	3	5	3	13	55	16	3		4	14	35	9
	20	3	12	8	14	5	12	3	7	1	13	8	12
	21	3	20	2	15		17	3		5	14	15	6
	22	Building locked						3	18	3	13	11	8
	23												
	24	3	10	2	15	35	9	2	55	9	13	31	17
	25	3	13	1	13	55	13	2	54	9	12	34	16
	26	3	10	4	13	40	3	2	48	1	13	48	10
	27	3	8	4	13	55	8	2	43	4	13	13	10
	28	3	10	2	15	5	10	2	48	5	12	5	15
	29	3	11	8	14	30	13	2	48	2	13	8	6
Mar	1												
	2	3	35	7	14	40	9	3		3	12	42	10
	3	2	55	7	13	23	14	2	45	3	12	36	14
	4	3	1	8	13	35	22	2	56	4	13	13	6
	5	3	4	7	13	10	10	3	1	3	13	30	11
	6	3	12	3	13	6	11	2	57	7	13	50	12
	7	3	1	4	12	40	10	2	42	9	11	56	13
	8												
	9	2	48	5	13	10	16	2	35	5	11	49	10
	10	2	49	5	12	50	10	2	31	9	12	15	12
	11	2	48	7	13	40	8	2	33	3	12	30	7
	12	2	48	6	13	18	11	2	30	4	12	18	13
	13	3	6	4	13	10	16	2	29	2	14	28	10
	14	3	2	5	12	28	14	2	39	7	11	36	25

TABLE 1—Continued

Time of practice	HILL						REJALL					
	Same 100-word paragraph			300-word page of new material			Same 100-word paragraph			300-word page of new material		
	Minutes	Seconds	Errors per 100 words	Minutes	Seconds	Errors per 300 words	Minutes	Seconds	Errors per 100 words	Minutes	Seconds	Errors per 300 words
Mar 15												
16	2	49	3	13	5	6	2	37	6	13	25	14
17	3	20	2	12	35	11	2	25	6	11	47	24
18	3	3	3	12	37	12	2	30	10	12	9	12
19	3		5	12	20	13	2	24	7	11	38	12
20	2	50	6	12	50	11	2	23	6	11	55	7
21	3	10	2	12	35	16	2	39	8	11	45	14
22												
23	2	50	5	12	30	9	2	20	6	10	51	14
24	2	48	4	13		15	2	21	13	11	49	4
25	2	55	3	12	30	12	2	18	5	11	40	14
26	2	53	6	12	20	18	2	25	10	10	58	15
27	2	48	9	13	30	9	2	18	11	12	7	5
28	2	59	6	11	45	6	2	28	6	13	22	8
29												
30	2	48	3	12	50	14	2	18	9	11	43	9

minute with 3.1 errors per hundred words. On February 24, 25 and 26, after 7.1 and 29.7 hours of practice of the two kinds, his respective scores were 31.4 words per minute with $2\frac{1}{3}$ errors and 20.9 words per minute with 2.8 errors. On March 27, 28 and 30, the last three days of the experiment, after 8.6 hours and 36 hours of practice, his scores were 35.2 words per minute with 6 errors per hundred words, and 23.4 words with 3.2 errors.

The corresponding facts for Rejall are as follows: On the first day, the 100-word paragraph at 6.3 words per minute with 8 errors, the 300-word page at 6.8 words per minute with 11.3 errors per hundred words. On November 30, December 2 and December 3, after practice of $2\frac{3}{4}$ hours with the same paragraph and 10 hours with changing material, his scores were 23.6 words per minute with $6\frac{1}{3}$ errors per hundred and 16.5 words per minute with 7.6 errors per hundred words. On February 1, 3 and 4, after 5.2 hours and 20.9 hours of practice, his scores were 32.6 words per minute with $4\frac{1}{3}$ errors per hundred words and 19.9 words per minute with 3.8 errors per hundred words. On March 23, 24 and 25, after 7.2 and $30\frac{1}{2}$ hours of practice respectively, his scores

were 42.9 words per minute with 8 errors per hundred words and 25.2 words per minute with 3.6 errors per hundred words. A week's added practice ($\frac{1}{4}$ and $1\frac{1}{4}$ hours) left these scores unimproved.

The improvement per hour of practice was greater in the case of Hill and Rejall than in the case of the subjects studied by Swift and Schuyler and Book, perhaps because the practice was distributed in much shorter period-lengths, perhaps because of individual differences such as made Rejall improve more rapidly than Hill. Using all these investigations together it appears that forty hours of well-distributed practice will enable an intelligent student to copy on the machine approximately as fast as he can by hand.

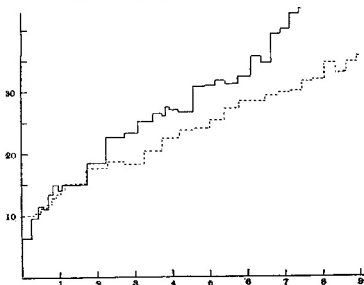


FIG. 1. The Curves of Improvement in Typewriting the Same 100-Word Paragraph. Equal lengths along the base line represent equal amounts of time given to practice. Equal heights above the base line represent equal numbers of words written per unit of time. The continuous line is for Rejall; the dash line is for Hill. The figures below the base line stand for hours of practice with the 100-word paragraph alone (i. e., exclusive of the practice with changing material).

THE LIMIT OF IMPROVEMENT

In the case of copying changing material there is, of course, no question of approach to a limit to improvement. It is also

the case that the limit was not reached by either Hill or Reja in copying the same paragraph, their rates for the last eight weeks of practice being, in order, as follows (in words per minute) :

Hill	Reja
26.2	31.7
29.8	31.1
31.3	32.3
31.5	35.5
31.9	34.5
34.5	39.2
33.0	40.0
34.8	42.2

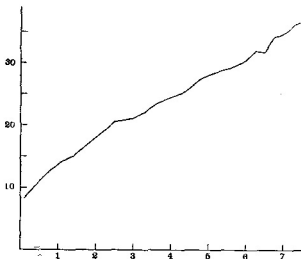


FIG. 2. The Average of the Two Curves of Fig. 1.

CHANGES IN THE RATE OF IMPROVEMENT

The practice curves for the speed of writing the same 100-word paragraph are shown in Fig. 1. The average curve is shown in Fig. 2. After the first few days these curves are plotted from weekly averages. The effect of any justifiable scheme of penalizing for errors upon the curves would be slight. Hill's curve shows no considerable fluctuations save the initial rapid rise, the failure to improve in Day 2 over the record of Day 1, and the drop during a week that included four days of illness. Reja's curve shows a more pronounced initial rapid rise and also the appearance of a positive accelera-

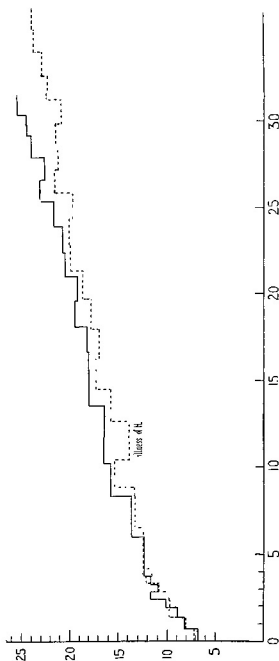


FIG. 3. The Curves of Improvement in Typewriting with Changing Material. Arrangement as in Fig. 1, save that the figures below the base-line stand for hours of practice with new pages alone, (i.e., exclusive of the practice with the too-word paragraph).

tion in the last 100 minutes of practice. The absence of general negative acceleration—that is, of a parabolic form for the curve as a whole, and of any clear ‘plateaus’ or ‘resting stages’ is noteworthy.

The practice curves for the speed of copying new material are shown separately in Fig. 3; the average of the two is shown in Fig. 4. After the first few days the curves are plotted from weekly averages. These curves would be only slightly altered by any rational penalizing for errors. Except for the rapid initial rise and the drop in the case of Hill during a week that included four days of illness, there are no notable departures from a straight slope, representing uniform increments in speed per hour of practice.

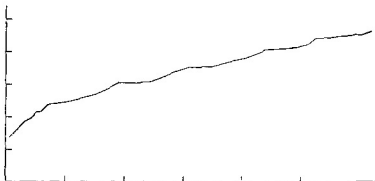


FIG. 4. The Average of the Two Curves of Fig. 3.

THE PERMANENCE OF IMPROVEMENT

The records in the case of Rejall for the first day of the 114 in '07-'08, for the last ten days of the 114, and for the memory test four years and a half later, are shown in Table 2.

There was evidently a very great permanence of the old learning. After writing the paragraph fifteen times and writing fifteen of the 300-word pages, the efficiency with the single paragraph was as high as had been attained by a hundred and fourteen such exercises four and a half years before. Five hours of practice with changing material (plus about an hour on the same paragraph) brought Rejall to very nearly the same ability with changing material that thirty hours had been required to attain originally. His average score in the six days after five hours of relearning was 26 words per minute, with $5\frac{1}{2}$ errors per hundred words.

TABLE 2--THE PERMANENCE OF IMPROVEMENT IN TYPEWRITING

	ORIGINAL PRACTICE							RELEARNING AFTER 4½ YEARS					
	Same 100-word paragraph			300-word page of new material				Same 100-word paragraph			300-word page of new material		
	Minutes	Seconds	Errors per 100 words	Minutes	Seconds	Errors per 300 words		Minutes	Seconds	Errors per 100 words	Minutes	Seconds	Errors per 300 words
1907-8							1912						
Nov. 1	15	53	8	43	50	34	Oct. 1	4	52	3	18	50	19
Mar. 19	2	24	7	11	38	12	2	3	55	3	16	...	24
	2	23	6	11	55	7	3	3	30	7	15	55	22
	2	39	8	11	45	14	4	5	30	4	14	15	19
	2	20	6	10	51	14	5	...	...	...	...	...	...
	2	21	13	11	49	4	6	...	...	...	...	...	...
	2	18	5	11	40	14	7	3	20	8	13	35	15
	2	25	10	10	58	15	8	3	5	4	13	20	26
	2	18	11	12	7	5	9	3	...	4	14	50	13
	2	28	6	13	22	8	10	2	50	11	14	25	13
	2	18	11	12	7	5	11	3	...	6	13	25	17
	2	28	6	13	22	8	12	...	...	...	...	...	...
	2	18	9	11	43	9	13	...	...	...	...	...	...
	2	48	6	13	...	20	14	2	48	6	13	...	20
	2	40	7	12	45	17	15	2	40	7	12	45	17
	2	40	7	13	55	21	16	2	40	7	13	55	21
	2	40	7	13	40	18	17	2	40	7	13	40	18
	2	20	3	13	15	12	18	2	20	3	13	15	12
	2	30	7	14	5	22	19	...	...	...	...	...	...
	2	15	5	13	...	22	20	2	30	7	14	5	22
	2	15	7	12	...	10	21	2	15	5	13	...	22
2	15	7	12	...	10	22	2	15	7	12	...	10	
2	25	8	12	15	20	23	2	25	8	12	15	20	
2	30	10	12	20	10	24	2	30	10	12	20	10	
2	30	7	12	...	18	25	...	...	...	...	...	...	
2	30	9	11	50	27	26	...	...	...	...	...	...	
2	30	8	12	...	16	27	2	30	7	12	...	18	
2	30	8	12	...	16	28	2	30	9	11	50	27	
2	30	7	11	40	31	29	2	30	8	12	...	16	
2	20	9	11	20	21	30	2	30	7	11	40	31	
2	15	11	11	30	15	31	2	20	9	11	20	21	
2	15	11	11	30	15	32	...	...	...	...	...	...	
2	30	8	12	...	16	33	...	...	...	...	...	...	
2	18	6	12	35	24	34	2	15	11	11	30	15	
2	14	7	10	46	17	35	Illness	...	...	...	...	...	
2	30	8	12	40	16	36	2	30	8	12	40	16	
2	18	6	12	35	24	37	2	18	6	12	35	24	
2	14	7	10	46	17	38	2	14	7	10	46	17	
2	12	9	10	54	16	39	...	...	...	...	...	...	
2	13	5	10	59	10	40	2	12	9	10	54	16	
2	13	5	10	59	10	41	2	13	5	10	59	10	

TABLE 3—AVERAGE DAILY CHANGES IN THE TIME REQUIRED TO TYPE-
WRITE X WORDS, DUE TO PRACTICE FROM MONDAY TO SATURDAY,
AND CHANGES FROM SATURDAY TO MONDAY. MINUS SIGNS
EQUAL GAINS

		INDIVIDUAL A. E. R.		INDIVIDUAL L. B. H.	
		New Material: 300-word page	Same Paragraph: 100 words	New Material: 300-word page	Same Paragraph: 100 words
Nov 4-9		-130	-38	-54	-32
Nov 9-11		+200	+57	-72	-20
Nov 11-16		-81	-13	-17	-4
Nov 16-18		-135	-97	-137	-39
Nov 18-23		+9	-3	-9	-5
etc.		-102	-51	-50	+4
		-20	-3	-10	-2
		+62	+14	+132	+50
		-13	+4	-37	-16
		+51	-21	-35	+17
		-1	-5	+2	-2
		-15	+3	-145	-8
		-33	0	+5	-5
		+25	+11	+56	0
				-27	-2
				+137	0
				-22	-4
				+55	0
		-28	-5	-20	+1
		+170	+19	-15	0
		-49	-4	-12	+1
		-67	-37	+36	-15
		+15	+2	+8	-3
		+70	+9	+25	0
		-17	-5	-2	-1
		+8	+2	-73	-6
		-10	+1	-8	+2
		+42	+14	+60	-2
		0	+1	-5	+1
		-88	-30	-50	-16
		-8	+4	+23	+1
		+20	-23	+35	-10
		-5	-1	-13	0
		-16	+12	+10	+24
		-9	-4	-24	-7
		-7	-7	+30	-13
		-3	+1	-8	+3
		+49	-2	+37	-13
		-20	0	-6	+4
		-54	-19	-5	-20
		+30	+2	-9	+2
		-89	-10	+65	-13

THE CONDITIONS OF IMPROVEMENT

The conditions of improvement in typewriting were not especially studied by Rejall and Hill, but their data permit us to study one sample question,—namely, that of the influence of the Sunday rest,—and to note the apparent effect of practice during an illness.

Comparing the gains from Saturday to Monday with the average gain from any one day to another from Monday to Saturday, we find the facts of Table 3.

Table 3 does not tell a very clear story, for the Sunday effect is not alike for the two sorts of work, and is not closely the same for the two individuals. In general it seems favorable for improvement in writing the same short paragraph, and unfavorable in the case of the changing material. There are also complications due to a difference, if the figures are taken at their face value, between the early and the late months of practice. The main facts appear more clearly if we combine each three successive week-records of Table 3, and replace the measure of gain by measures of the *superiority* of the Sat.-Mon. gain to the average gain from day to day between Monday and Saturday. A minus sign will equal *inferiority*. We then have Table 4.

TABLE 4—SUPERIORITY OR INFERIORITY OF THE SATURDAY-MONDAY GAINS

	A. E. R.		L. H. B.	
	300-word page	100-word paragraph	300-word page	100-word paragraph
First 3 weeks.....	—55	+12	+59	+4
Second 3 weeks*....	—48	—3	—1	—27
Third 3 weeks.....			—98	—4
Fourth 3 weeks.....	—79	+1	—24	+5
Fifth 3 weeks.....	+4	+4	+16	+9
Sixth 3 weeks.....	—6	+6	—30	—2
Seventh 3 weeks.....	+33	+11	—40	+18
Average.....	—25	+5	—17	0

*4 in the case of A. E. R.

The change from early to late months appears most clearly if Table 3 is condensed into three divisions for the first nine, the next six, and the last six, and if the two individuals' records are averaged. We then have Table 5.

It appears that in writing the 100-word paragraph during the last twelve weeks practically no improvement was made from Monday to Saturday.

TABLE 5—AVERAGE DAILY CHANGES IN THE TIME REQUIRED TO TYPEWRITE X WORDS, DUE TO PRACTICE FROM MONDAY TO SATURDAY AND THE CHANGES FROM SATURDAY TO MONDAY

Average change from one practice-day to the next. Minus signs equal gains.

	MONDAY TO TUESDAY, ETC		SATURDAY TO MONDAY	
	300-word page	100-word paragraph	300-word page	100-word paragraph
In the first 9 weeks.....	-26	-9	+2	-7
In the next 6 weeks.....	-11	-1	+10	-6
In the last 6 weeks.....	-5	0	+7	-8

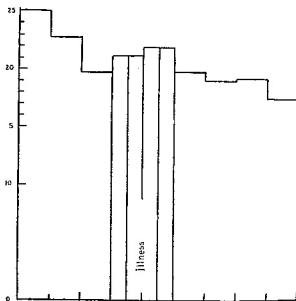


FIG. 5. Efficiency in Typewriting the Same Paragraph of 100 Words, before, during, and after illness. Subject, Hill. (Each unit along the abscissa equals three days; the two three-day periods of the illness are so marked; the height of the curve equals the time required to copy the paragraph.)

The only notable differences in physical condition reported were an illness of several days (Dec. 2, 3, 4 and 5) and a bad cold on one day (Jan. 4), both in the case of Hill. The latter seemed to slacken improvement somewhat; the former was almost surely associated with such slackening. The ordinary ups and downs from day to day were so great that the trend of the curve over a fairly long interval has to be examined for evidence. Figs. 5 and 6 show the facts in the case of the longer illness. There can be little doubt of the harmful temporary effect of the illness on efficiency, and it seems to have reduced improvement in the case of typewriting new material. That the practice during the illness was any less beneficial than ordinary practice to the function of copying the same paragraph, seems dubious.

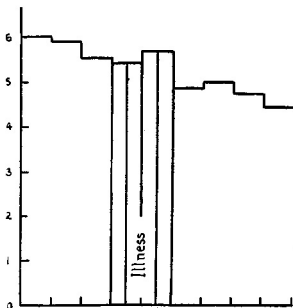


FIG. 6. Efficiency in Typewriting New Material, 300 Words Daily, before, during, and after illness. Subject, Hill. (Each unit along the abscissa equals three days; the two three-day periods of the illness are so marked; the height of the curve equals the time required to copy 300 words.)